

"Approaches to Improving Transmon Qubits"

R&D Status Report

Reporting Period: (November 15, 2009 to December 15, 2009)

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Approaches to Improving Transmon Qubits

Monthly Progress Report

November 15 – December 15, 2009

Progress

- 1) We have completed fabrication at JHU/APL of a variety of microwave resonator cavities. The devices have been diced and are ready for use. We have:
 - a. Sapphire substrate, aluminum lift-off
 - b. Sapphire substrate, niobium lift-off
 - c. <110> silicon substrate, aluminum lift-off
 - d. <110> silicon substrate, niobium lift-off
- 2) The machine shop finished fabrication of our specially-designed evaporator jig to allow double-angle evaporation (to form the transmon with a single e-beam step).
- 3) We have made arrangements to use an e-beam lithography system on the JHU campus and one of us has finished training on the machine. We are now allowed full access to the system.
- 4) We have completed simulations of the trench shunt capacitors and have started the design process for the first round of fabrication.
- 5) We have received the quartz substrates and thus can start the trench etching process.

Planned activities

- 1) Complete Princeton subcontract – we have now enumerated all contractual issues and hope to resolve them shortly.
- 2) Ship a selection of microwave resonator cavities to Princeton for measurement of Q values.
- 3) If Q values of resonators are sufficient, start e-beam lithography of transmons at both Princeton and JHU.
- 4) Fabricate resonator cavities in aluminum and niobium on quartz substrates.

Major Expenditures

None

Changes in key personnel

None

Meetings/trip reports

None this period

Problems

- 1) It is taking much longer than anticipated to work out the subcontract with Princeton, as they took exception to some of JHU/APL's standard contractual provisions. Contracting officers from both institutions are actively involved and we anticipate that we will resolve these issues shortly.
- 2) The instrument we planned to use to measure femtofarad capacitances is broken and it may not be possible to repair. We are actively pursuing other options.

Related accomplishments

None

Fiscal status

No issues – financial data for November 2009 is presented on the following page.

R&D Status Report
Program Financial Status – November 2009

Work Breakdown Structure or Task Element	Planned Expend	Actual Expend	% Budget Complete	At Completion	Latest Revised Estimate	Remarks
Phase 1	50,020	30,643	10.2%	299,992	299,992	
Phase 2				91,793	91,793	
Subtotal						
Management reserve:						
Or Unallocated Resources:						
Total:	50,020	30,643	10.2%	391,785	391,785	

	Is current funding sufficient for the current fiscal year (FY)? (Explain in narrative if "NO")
	NO. Current funding is sufficient to cover estimated costs through June 2010, or Phase 1 of the program. We will need Phase 2 funding by the end of June 2010 to work after that date.
	What is the next FY funding requirement at current anticipated levels?
	We anticipate receiving an additional \$91,793 for Phase 2 of the program on or before June 2010.

	Have you included in the report narrative any explanation of the above data and are they cross-referenced?
	YES